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ABSTRACT

High speed data services known as broadband have the potential to make rural areas less isolated and improve the rural quality of life, but physical barriers, sparse population density, and few markets present significant obstacles to their deployment in rural areas. Broadband applications such as e-commerce, distance education, and telemedicine require a communications infrastructure that can move large amounts of data quickly. Currently, many rural regions lack such an infrastructure because broadband is limited by technological constraints prevalent in rural regions. Since providers are not required to offer broadband services to all regions, smaller communities are not top priorities. Satellite technology is the best hope for rural areas but will probably not be available until 2002-03. In addition, an exemption in the Telecommunications Act of 1996 for small rural telephone providers serves as an obstruction to those who would offer broadband in rural areas. Legislative and regulatory developments may help. The FCC is considering applying the definition of universal service to broadband services. If that happens, public funds would be available to offset the costs of bringing broadband to rural America. Bills addressing high-speed data and rural regions have been introduced in the U.S. Senate and House of Representatives. (TD)

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The Main Street Economist

Commentary on the rural economy

The Broadband Quandary for Rural America

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As information technology continues to change our lives, rural America finds itself in a quandary. Many small rural communities face the twin challenges of attracting new businesses and stemming a population outflow. Both challenges can be helped by advances in telecommunications. But the very things that lie behind the challenges—isolation, distance, low population density—may also keep advanced telecom services from ever being deployed. Central to this problem in rural America is the outlook for broadband, or high-speed data transfer.

Broadband applications, such as e-business and telemedicine, require a communications infrastructure that can move large amounts of data quickly. Currently, many rural regions lack such an infrastructure. Whether it will ever exist depends on Main Street's ability to overcome two hurdles. First, rural markets often represent low priorities for the telecommunications providers that would serve those areas. Second, broad-

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band is limited by technological constraints that are prevalent in rural regions. Overcoming these twin hurdles may ultimately require assistance from policymakers and significant effort from rural communities.

What is broadband?

The term broadband refers to technologies that allow a user to move data, access the Internet, and use Internet-related services at speeds that are significantly higher than the speeds offered by standard modems. According to the Federal Communications Commission, a broadband connection provides a speed at least four times faster than 56 kilobits per second, the maximum speed offered through regular telephone lines. Many broadband technologies offer dramatically higher speeds, over 100 times faster than standard dial-up access.[1]

The advantages of such speed are obvious. A typical medical image file, such as a series of X-rays, converts to a compressed file roughly 24 megabytes in size. Broadband mechanisms, such as DSL lines or cable modems, convert the downloading time of such a file from hours to mere seconds (Table 1).

In most cases broadband is offered throughout a local market using one of three technologies.[2] Telephone companies offer *DSL*, or digital subscriber line, which uses the telephone network and can offer speeds up to 8 mbps. Cable television companies offer *cable modems*, which use an upgraded version of the cable TV network and offer speeds even faster than DSL, up to 10 mbps. The majority of current broadband customers use one of these two technologies. The third technology, *wireless*, can use either satellite or microwave transmission with top speeds ranging from 2 mbps to 10 mbps.

For rural residents, broadband services offer huge potential benefits:

- Distance learning allows students in small towns to access information and instruction previously unavailable to them, instructional content that can be shared among multiple schools that a single institution might not be able to support on its own.

- Telemedicine can overcome distance limitations in medical treatment. Services such as video conferencing, teleradiology (sending X-ray images via electronic channels), and remote diagnostic testing can offer rural patients access to the same quality of care as that of urban residents.

- E-business provides an opportunity for new firms to locate in smaller communities and for established businesses to redefine themselves. For example, farmers and ranchers will need broadband infrastructure to take full advantage of real-time auctions and newly formed electronic exchanges, and to download pertinent information such as weather and soil conditions.

Table 1
Time required to download a 24 megabyte file of X-ray images

SPEED	TIME
14.4 kbps	3.6 hours
28.8 kbps	1.8 hours
56 kbps	58 minutes
128 kbps	24 minutes
1.54 mbps	< 3 minutes
4 mbps	48 seconds
10 mbps	< 20 seconds

High costs make rural markets low priorities

While the benefits that would flow to rural areas from broadband deployment are obvious, realizing these benefits may be difficult. Perhaps the primary challenge is that rural communities do not represent prime markets to many broadband providers. Unlike basic utilities, companies that provide broadband services are not obligated to offer services to all regions, or even to all customers in a region. Broadband services are offered at the discretion of the provider, and due to the high costs involved many smaller communities simply do not represent top priorities for these providers. All three technologies—DSL, cable modems, wireless—require a significant investment in equipment and involve large set-up costs. So any provider would naturally seek out the largest potential market to recover those costs.

In addition, for either DSL or cable modems to function, the network used (telephone, cable TV) must be upgraded, often at significant cost. These upgrading costs provide additional incentive for companies to prioritize larger markets. The cost of conditioning, or upgrading, a mile of telephone network is the same whether it serves 20 households or 200. Recent estimates of the cost of upgrading either the telephone or cable TV network for rural areas of the United States run as high as 30 billion dollars, a figure that excludes the cost of additional electronics needed to actually provide the service.[3]

Given these facts, it is not surprising that general broadband deployment in rural regions is rare. For cable modems, 72 percent of communities over 250,000 have some type of cable-based broadband, but less than one-fifth of 1 percent of communities under 1,000 have cable modems deployed. Similarly, for DSL, in regions served by the largest local companies, such as Bell South or GTE, 86 percent of communities with 250,000 residents have some amount of DSL deployed while virtually no communities under 1,000 have DSL. This finding illustrates an important point regarding rural broadband service: the size and scale of the existing telephone or

cable TV provider can affect the likelihood of DSL or cable modems being offered in small communities or rural areas.

Large vs. small carriers: different priorities, different results

Although larger companies are often likely to possess the financial health to deploy broadband, it may be that many rural communities are better served by smaller, independent companies. As opposed to a large nationwide provider, a smaller local company is less likely to overlook the community in search of larger markets. A study by the National Exchange Carrier Association showed that approximately 65 percent of rural telephone lines served by smaller telephone companies will be broadband-capable by 2002. The National Telephone Cooperative Association has reported that 33 percent of their member coops plan to deploy DSL by the end of this year.

In addition, rural areas served by smaller companies may have an infrastructure that requires less conditioning or upgrading than the infrastructure owned by larger companies. In the past ten years, many smaller companies have invested in infrastructure that was funded through the Rural Utilities Service (RUS), a division of the U.S. Department of Agriculture. One condition for receiving RUS funding is that the network must be capable of supporting advanced services such as DSL. Since 1993, RUS has funded nearly $2 billion in rural infrastructure for smaller companies.

These trends are encouraging for rural areas served by small companies. But the sobering fact is that large, nationwide providers actually serve a majority of the households in rural areas, and a significant subset of the households in extremely remote areas (Chart 1).

The same is true for cable companies. According to the FCC, over 50 percent of the most rural U.S. counties receive cable TV from the largest, multi-state cable TV providers. So, for much of rural America, the first challenge remains finding a way for larger companies to focus on nonurban areas when they are not obligated to do so. But even if large providers do focus their attention on smaller communities, it is likely that many rural residents will still be left without broadband service.

Distance is still a significant barrier

Residents living in remote or outlying areas present a special problem for both large and small broadband providers. Over a million U.S. households are located in extremely low-density areas, regions that are home to less than five people per square mile. For both DSL and cable modems, these sparsely populated, outlying areas present unique technical problems that go beyond any market-based considerations.

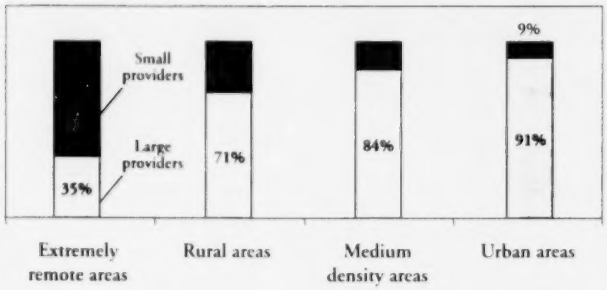
In the case of DSL, the advantages of using the existing telephone network are limited by a technological constraint. The higher speeds are only effective when customers are located less than 18,000 feet from the telephone company's central office. This hurdle can be overcome by replacing portions of the copper phone line with fiber, but the cost of doing so is considerable. Interestingly, this distance issue is not limited to rural areas. In many suburban areas, customers are located more than 18,000 feet from their central office. However, in those areas the number of potential customers is often large enough to justify the cost of replacing copper with fiber. In rural areas, it is not.

In the case of cable modems, distance constraints also apply but may be less problematic. The maximum acceptable distance is approximately 16,000 feet from the customer's home to a *node*, which is a component of the cable TV network. But because the node is often located in neighborhoods, closer to residences, this distance limit may be less constraining. For cable, the larger problem is that the network itself does not reach many remote and outlying areas. Historically, cable providers have often been unwilling to build their networks into regions that have a density less than ten subscribers per mile, and this hesitancy has grown with the increased competition from satellite TV providers. Industry sources estimate that 3 to 5 million U.S. households do not have wireline cable available to them, making them noncandidates for cable broadband.

For these remote areas the best potential broadband solution may be wireless technology, specifically satellite. The key factor that sets satellite technology apart from all other options is that cost and efficiency do not depend on density. Cost per customer is the same whether 1,000 customers are packed into two city blocks or spread across two hundred square miles. No other technology can make such a claim, even other wireless offerings, such as fixed location microwave technologies. And although certain recent satellite ventures

Chart 1

Residents Served by Large, Nationwide Telephone Providers — By Area Type



Source: FCC Data

have encountered difficulties, several new satellite offerings are in the planning stages. A key difference will be that the newer systems will focus on data transfer, not just on voice communications. However, the majority of commercial satellite providers do not anticipate offering service until at least 2002–03.

Public policy may assist rural broadband deployment

While the challenges above are significant, developments in the legislative and regulatory arenas are taking place that may have an impact on rural broadband. Earlier this year, the FCC announced that it would re-examine the definition of *universal service* to determine whether it should include broadband services. Universal service is a policy that makes basic telephone service available to all U.S. households, even in extremely remote areas, through a combination of public funding and market forces. If the definition is expanded to include broadband services, it is possible that public funds would be available to offset the costs of bringing broadband to rural America.[4] A decision is expected by October 2000.

> ***"A lack of broadband infrastructure could limit the potential of [rural] communities to attract and retain businesses and jobs."***
>
> ***—FCC, February 2000***

In addition, until it recently adjourned, Congress was discussing market-based incentives to spur rural broadband deployment. Bills addressing high-speed data and rural regions had been introduced in both the Senate (Senate bills S.2698 and S.2307), and in the House (House bills H.R.4728 and H.R.4122). However, some members of Congress recently expressed doubts that the state of broadband service deployment is a problem that requires assistance from the U.S. government. Whether or not these or other bills will be debated in upcoming sessions may in part depend on the outcome of the FCC's decision on universal service.

On the other hand, some existing policies built into the 1996 Telecom Act may have the unintended effect of impeding the provision of rural broadband. According to the Act, large telephone companies are required to make their infrastructure available to competitors, including competitors intending to offer high-speed data services. But smaller, independent telephone companies have no such requirement. The result is that in areas served by smaller companies, a new competitor must build its own infrastructure. Clearly, this translates to a significant cost disadvantage. Whatever the original intent of this exemption for small companies, the effect is actually to create a barrier to entry. In fact, this exemption serves as an interesting commentary on just how rapidly the world of high-speed data services has grown. In 1996, when the Telecom Act was written, the exemption was viewed as a safeguard for small, rural telephone providers who did not possess the scale economies to compete with large companies. Now in 2000 it serves as an obstruction to those who would offer broadband in those areas.

Conclusion

It is clear that the introduction of broadband in smaller communities will play a vital role in rural America's survival. A communications infrastructure that can support high-speed data will not solve all of Main Street's problems, but it can work in a synergistic way with other rural economic assets to attract and retain businesses and residents. In short, it will help level the playing field between urban and rural America. But several questions remain unanswered. Given the existing challenges, it is unlikely that market forces alone will ensure universal access to broadband. Will policymakers step in to help fill the gap? Or will many areas have to rely on advances in technology to make rural broadband a profitable venture? The answers to these questions will have an important impact on the future course of the rural economy.

[1] Top speeds for broadband services can easily exceed 10 megabits per second (mbps), which is 10 million bits per second.

[2] Broadband is also offered on a customer-specific, or dedicated basis. This article focuses on general, market-wide deployment.

[3] Telephone network estimate from NECA, the National Exchange Carrier Association. Cable TV network estimate from the FCC.

[4] These public funds are the federal universal service high-cost fund. The source of the fund's dollars are payments made by telephone companies, and these are usually passed through to the telephone companies' customers.

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